THE EFFECTS OF LIGATING THE TESTES OF HEN-FEATHERED COCKS.

T. H. MORGAN.

It has been shown that when hen-feathered males of certain races of poultry (Sebrights, Campines) are castrated the new feathers have the characteristics of the cock-feathered males. The operation of castration is dangerous for adult birds with large testes because the birds often die from hæmorrhage from

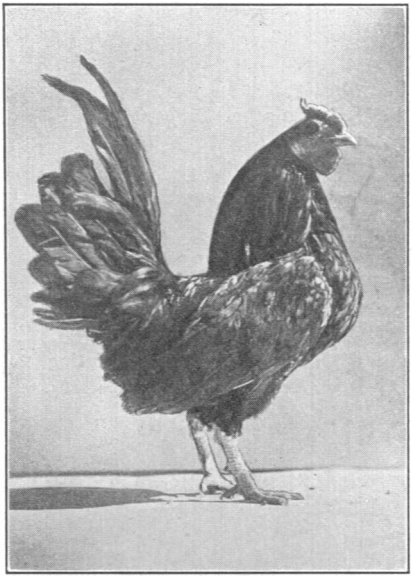

FIG. 1. Sebright whose testes had been tied off September 29, 1919; the photograph was taken April 8, 1920.

the spermatic blood vessels, yet in order to be certain that a cockerel is going to be hen-feathered it is necessary (except when races pure for hen-feathering are used) to operate on adult birds. As these are often too valuable to risk the chances of an unsuccessful operation I have tried to find out whether the same

end results may not be obtained by ligating the testes. If a silk thread is tied tightly around the attachment of the testis to the

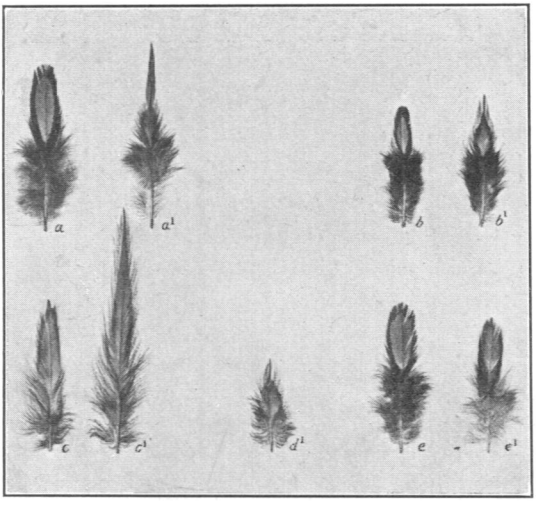

FIG. 2. Original feathers of Fig. 1, *a*, *b*, *c*, *d*; new feathers a^1–e^1.

body wall, thus cutting off the circulation to and from the testis, the organ degenerates and in a short time is absorbed. In order

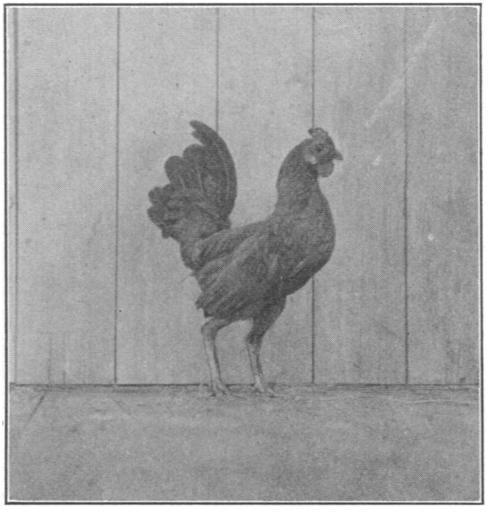

FIG. 3. Hen-feathered, back-cross, "Lamey."

that the results shall be clean cut it is necessary that the entire testis be included in the ligature, for, if even a small piece is left, it may subsequently enlarge and make the outcome less complete.

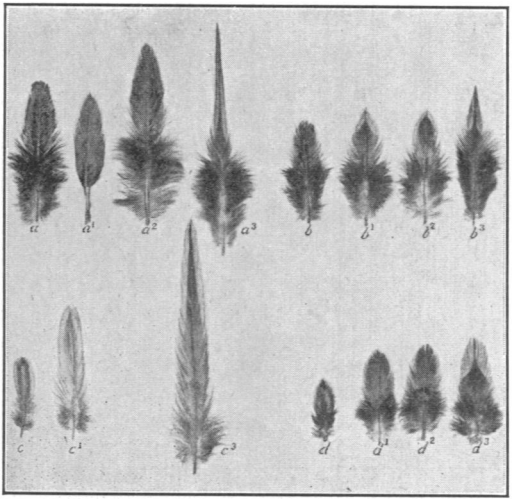

FIG. 4. Original feathers *a–e* of Fig. 3, and later feathers, a^1–e^1, a^2–e^2, a^3–e^3, July 7, September 17, and March 13, 1920.

In fact, as the following cases show, only one case of the four was completely successful, although all of the other three cases

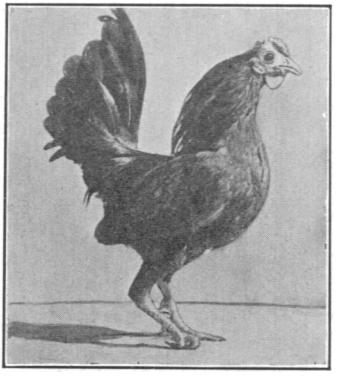

FIG. 5. Same as Fig. 3, after ligation, March 2, 1920.

were sufficiently successful to cause some change in the plumage in the direction of cock-feathering.

The first bird was a pure Sebright male more than a year old. It was a typical bird of its race, *i.e.*, it was completely hen-feathered. This bird had been used in an experiment a month earlier to induce beri-beri, but had fully recovered. I had seen a statement in *Science* that young chicks are peculiarly susceptible to a lack of vitamines in their food and that beri-beri can be induced

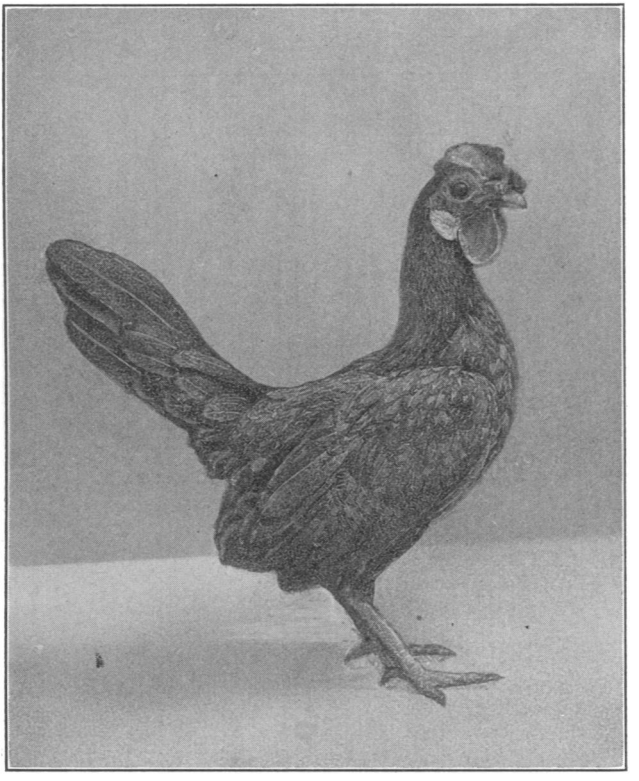

FIG. 6. Hen-feathered, back-cross, rose comb, No. 270, June, 1919.

by a diet free from or low in vitamines. The possibility that the testes might also be affected by such a diet, and cause a change in a hen-feathered male of the same kind as that brought about by castration suggested the experiment. Two hen-feathered cocks were used. Both were fed on white rice for five weeks. No changes were observed to take place in their combs. Suddenly the effect of the diet became apparent, and in the course of

two days the birds almost died. They lay on the floor of the cage with their muscles convulsively contracted. They were immediately fed on milk by means of a pipette and later on bread and milk. In the course of a week they had completely recovered. At the time of the operation, a few weeks later, they were active and very healthy-looking birds.

The testes of the Sebright were tied off on Sept. 29, 1919. A few feathers from typical regions were pulled out and are shown

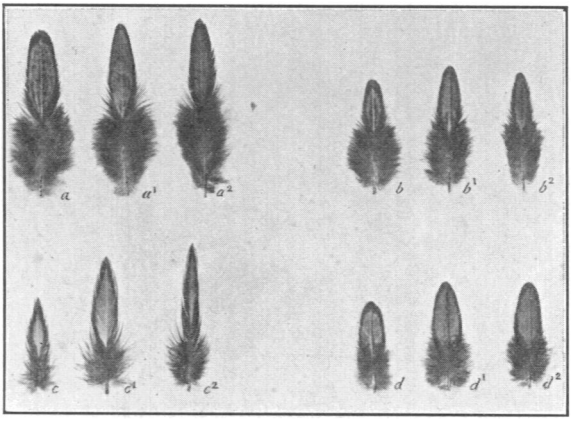

FIG. 7. Original feathers, *a–d* of Fig. 6; and later feathers, a^1–d^1, November 15, and a^1–d^2, March 15, 1920.

in Fig. 2, *a, b, c, e.* By Oct. 24 the new feathers had begun to come in. They were typical cock-feathers. When the last photograph was taken, Fig. 1, April 8, 1920, the bird had changed over almost completely to cock-feathering. The comb was small; not more than a third its original size. The extent to which the change had taken place is best shown in the feather-chart, Fig. 2, a^1–e^1, where one of each of the original kinds of feathers is placed side by side with the new feather from the same region.

The second bird operated upon, called "Lamey," Fig. 3, was a yellow, back-cross, hen-feathered cockerel, one year old. Its testes were ligated in May, 1919. It went over towards cock-feathering during the summer (July, 7), as shown by the feather-chart, Fig. 4, a^1, b^1, c^1, d^1. Both the old and the new feathers were present at this time and one of each from typical regions

is shown beside the other. As the change had not gone as far as expected, had the ligation been entirely successful,[1] the bird was opened on September 17. Its feathers at this time are shown in Fig. 4, a^2, b^2, c^2. Pieces of the testes were found present and an attempt to remove them was made. During the winter the bird showed somewhat further changes in his plumage as new feathers developed. On March 13, 1920, he appeared as shown in Fig. 5. The condition of his feathers is shown in Fig. 4, a^3, b^3, c^3, d^3.

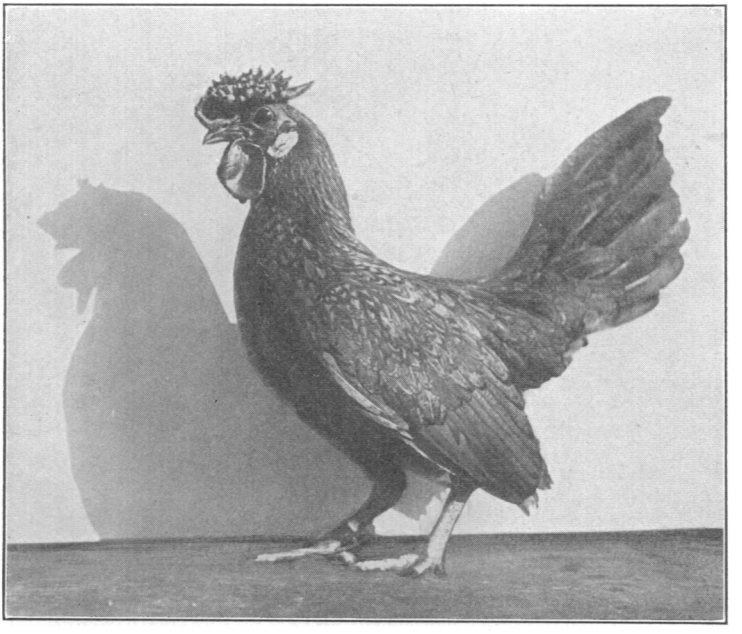

FIG. 8. Same bird as Fig. 6, November 15.

These show that the change had gone much further, as the smaller size of the comb would lead one to expect. He was killed on March 17, and examined. On the left side there was a small piece of testis about one fourth inch in diameter. On the right side there was a chain of very small pieces of testis. The comb measured two inches in length and one fourth inch in height. The wattles measured three quarters of an inch in diameter.

The third bird, (No. 270), was a rose comb, back-cross, hen-feathered cockerel, a year old (Fig. 6). The bird looked some-

[1] The condition of the comb showed that some testicular tissue remained.

what like a Sebright, but the yellow centers of the feathers were much mottled making the general effect of the plumage darker than that of the Sebright. Ligatures were put around the testes on July 10, 1919, but unfortunately one of them did not completely encircle the end of one testis, so that a piece was con-

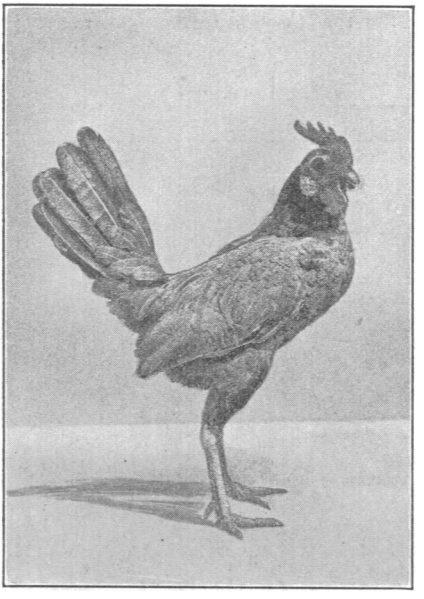

FIG. 9. Hen-feathered, back-cross, single comb, No. 62.

stricted off. This piece was left in position at the time. The feathers that came in (Sept.) underwent very little change, the centers becoming somewhat clearer, Fig. 7, a^1–d^1. The presence of a large comb made it certain that a considerable amount of the testes had remained active. On opening the bird (Nov. 15), no pieces of the left testis were found. On the right side there was a testis highly vascularized, attached to the body wall. It was removed and after the operation the comb became smaller; but after a while began to grow, until by March 8, it was quite large again. The bird might still be said to be almost completely hen-feathered (Fig. 8). It was killed and opened on March 17, 1920. On the left side was found a large, detached piece, berry-like in appearance, undoubtedly a regenerated testis. On the right side

a testis appeared almost normal in size. The comb measured one and a half inches high, and two and three quarters inches long. It is evident that the failure to change over except to a very small extent was due to the failure of the operation.

The fourth bird, No. 62, was a yellow, back-cross, single comb, hen-feathered cock, Fig. 9. Its testes were ligated on July 10,

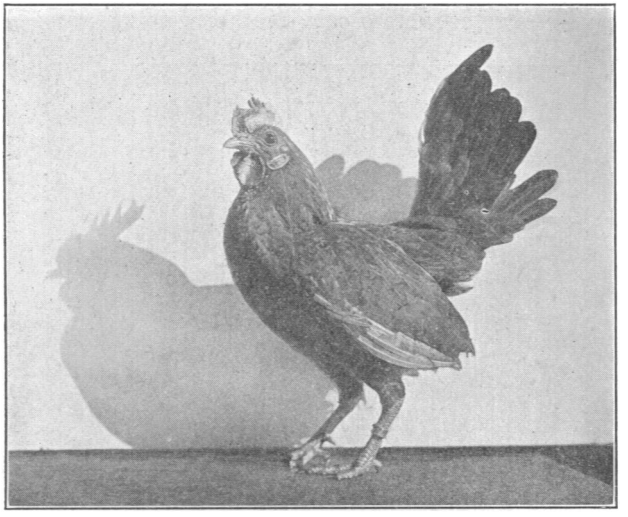

FIG. 10. Same as Fig. 9, November 15.

1919. He showed at first some effect of the operation, but his comb soon began to enlarge again. On November 15, he was still hen-feathered (Fig. 10). A comparison of the feathers of July 10 with those of November 15, Fig. 11, *a*, a^1, *b*, b^1, etc., shows little change. When opened at this date no trace of the testis was found on the left side. On the right side a large piece of testis-like tissue was present in a sheath tightly adherent to the body wall. It was opened and some very loose tissue(?) taken out. This was preserved for examination and the bird was closed up. It was kept alive until March 15. Its feathers at this time are shown in Fig. 11, a^2, b^2, c^2, d^2. The comb was large and the bird appeared to be nearly hen-feathered. It was killed and examined. On the left side there were two small pieces of testis which together were no larger than a pea. On

the right side there was an almost complete organ. The comb was large, measuring half an inch in height and two inches in length. Each wattle was one inch across. The condition of the testes accounts for the failure of the bird to change over.

These few experiments suffice at least to show that it is possible to cause the total degeneration of the testis if ligation is successful; and further that unless the testes are entirely removed the complete change-over to cock-feathering does not take place.

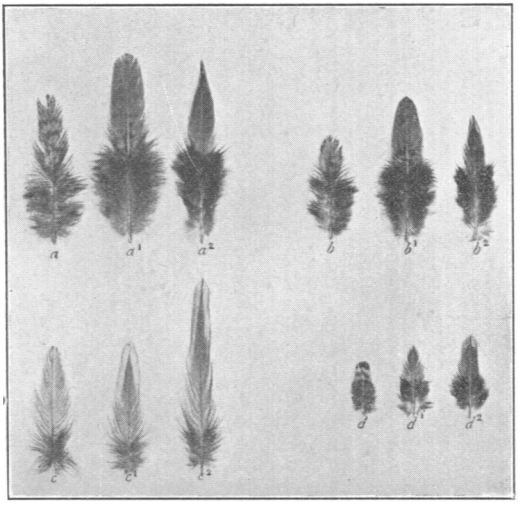

FIG. 11. Original feathers, *a*–*d*, July 10, and later feathers November 15, a^1–d^1, and March 15, a^2–d^2.

They also show, however, that some change in the direction of cock-feathering will take place if some of the testis is removed, and the amount of the change is roughly proportional to the amount of testis present. The comb is a sure index of the amount of the testes left. It appears that a smaller amount of the testis suffices to keep the comb at or near its normal size than to keep the feathers true to type for hen-feathering. For a complete change to cock-feathering it is essential that all of the testis be removed. These results accord fully with the results that I have obtained by castration. The chief significance of the results is to show that adult birds can be successfully used if ligating is employed instead of castration.